BY DEBORAH **PARKER WONG**

OZONE SANITATION

EXPANDS FROM WINERY TO VINEYARD

System uses ozone-charged water to deal with pests and diseases

In 1997 ozone was approved by the EPA as a safe and effective method of general sanitation for wineries. With the commitment to sustainable farming practices on the rise, it's now proving to be equally useful in the vineyard. Ozone, or O3, a bluish unstable gas that smells like the air charged by lightning during a thunderstorm, is generated when oxygen and electricity are combined. At high enough concentrations, ozone-charged water becomes a chemical-free alternative to pesticides.

Third-generation grower John Bacigalupi farms using many of the traditional methods he learned from his father and grandfather. Last year the Bacigalupi family marked its 50th year growing grapes in Russian River Valley and, in his efforts to be a better steward to the land, Bacigalupi continually adapts his farming practices to keep pace with the way pests and disease respond to chemical treatments.

"We've always had to rotate protocols to stay one step ahead of pests and mildew," he said. "And until recently, we would spray for mites every five years or so but now we're spraying every year." That undeniable increase led Bacigalupi to look for alternative ways to treat for the pests that didn't involve pesticides.

From the statuesque trunks of Chardonnay planted to the vineyard known as the Paris Tasting Block (the 1973 Chateau Montelena Chardonnay that won the famous "Judgment of Paris" tasting included Bacigalupi grapes) to the Pinot Noir that makes up the majority of his Russian River Valley estate, Bacigalupi's solution to the resistant mites and mildew still involves spraying. But now there's a small generator mounted to the top of a double-arm, over-row sprayer, a cabinet labeled AgriOzein bolted to the front end of a 500-gallon tank and not a chemical in sight.

"Typically we'd treat mildew with dusting sulfur every seven to 10 days," he said. "Now we're treating with an average of 140 to 200 gallons an acre of ozone-charged water and seeing far healthier vineyards as a result."

Growers such as Bacigalupi don't make unwarranted changes to their protocol. Both he and Chris Bowland of Bowland Vineyard Management in Santa Rosa, Calif., are among a group of early adopters using ozone in the vineyard as a contact treatment; one that destroys pests up to the size of a house fly, and rot, but not the surface tension of the leaves or berries (the plant's natural defense mechanism) or the environment.

Bowland began trialing AgriOzein on two blocks of high-density Chardonnay and Pinot Noir this year. His sprayer rig and protocol differ slightly from Bacigalupi's: he's spraying every 10 to 14 days using 40 to 50 gallons of water during the first stage of shoot growth. He first spotted the technology

AT A GLANCE

- Long used for winery sanitation, ozone is proving to be equally useful in the vineyard.
- When sprayed on vines, ozone-charged water is an effective contact solution for pests and mildew.
- Ozone-charged water is free of chemicals and residue.
- It's impossible to burn or damage vines with ozone.
- Adoption of chemical-free alternatives such as ozone will follow sustainable farming mandates.

The Bacigalupi family sprays its vineyards with ozone-charged water to control pests and diseases.

Third-generation grapegrower John Bacigalupi has adapted a standard over-row sprayer for applying AgriOzein treatments to his Russian River Valley vineyard.

online and decided to purchase a one-sided sprayer configured to his high-density sites. Wilmink's standard turnkey system – the Ozero – uses 39.7 gallons of water per acre and costs $27,000.

"With this technology, we're not using any chemicals in the vineyard," Bowland said. "And that helps protect the safety of our crew, our operators and our neighbors." He is looking at "ozogation" (Ernie Wilmink's term) as a likely curative for Botrytis, especially during cooler years when pressure is high.

OZONE IN THE FIELD

Developed by Nebraska-based Dutch water quality scientist Wilmink, AgriOzein initially evolved from a water treatment solution with a high oxidation reduction potential, or ORP. "We saw problems that traditional water treatment could not address," said Wilmink,

The AgriOzein system generates much higher concentrations of ozone than those required for winery sanitation tasks. Photo: Deborah Parker Wong

who described an early application for the technology at a golf course. "Their swimming pool was black and I discovered the chlorine wasn't sufficient to oxidize the organic iron in the well water they were using in the pool." Ozone technology was the solution, and Wilmink went on to develop ozone applications for agriculture including wine grapes.

"When water contains a high enough ORP, nothing can survive in it," he said. "But the initial challenge was to fine-tune ozone treatment to compensate for the factors that limit use in the field."

As an unstable gas, ozone readily reacts with both inorganic and organic matter. It sanitizes by charging, or "lighting up," cell walls and denaturing metabolic enzymes. Once its oxidizing potential has been released, ozone reverts back to oxygen, leaving no chemical residue.

With a half-life of just 10 to 20 minutes, ozone has to be electrically generated on demand using ultra-violet (UV) light or, in Wilmink's case, through a proprietary corona discharge (CD) plasma generator.

Natural levels of ozone in the environment range from 0.01 ppm to 0.15 ppm and can reach higher concentrations in urban areas. Winery sanitation tasks such as barrel washing require lower concentrations of ozone, typically 2.0 ppm, which can be generated by a UV system.

CD systems generate higher ozone concentrations, which, according to Wilmink, are dependent upon the size of the retention tank they're charging and the turnover rate at which they're being dispersed. For a 100-gallon tank, AgriOzein generates 12.5 ppm, a concentration that takes into consideration all of the variables found in the field to achieve the 750 Mv of ORP that make it a lethal oxidizer.

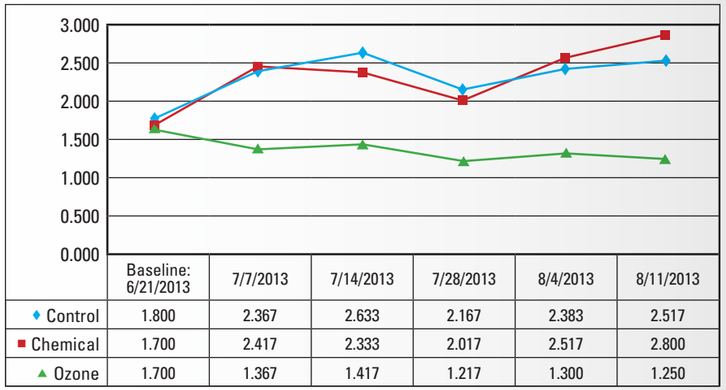
"Standard ozone machines charge water with ambient air," said Bacigalupi. "Wilmink's technology separates the nitrogen from the oxygen so the oxygen is more potent, which allows it to be hypercharged." Water can only hold so much ozone, so there's a natural threshold that makes it impossible to damage or burn the vines with ozone-charged water.

"Because we're not treating with surfactants, there's also a cosmetic benefit," Bacigalupi said. "It brightens the canopy."

OZONE ON TRIAL

According to Wilmink, AgriOzein has cleared the EPA and Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) hurdles regulating the use of chemicals. FIFRA classifies ozone as a regulatory-approved antimicrobial agent, but the EPA has regulated it as a pesticide based on its mode of delivery. Each AgriOzein unit now carries the requisite EPA establishment number, which is issued to any facility that manufacturers insecticides, fungicide and rodenticides. Now that the legality of ozone use outside the winery has been established, the rate of adoption for Wilmink's proprietary technique in the United States is likely to pick up speed.

In an address at the VitiNord conference held in Germany and Poland in 2012, Wilmink and University of Nebraska professor Max McFarland found a ready audience that included cold-climate wine-growers from Norway, China and Canada. Trials conducted in 2012 and 2013 by McFarland proved the efficacy of ozone in treating cold-hardy hybrids including Brianna, Edelweiss and Marechal Foch against the impacts of pests, rain and humidity in central and eastern Nebraska. Results varied by variety, with a best-case scenario for ozone-treated Brianna, which maintained low disease pressure through the 2013 growing season, while pressure on chemically treated and control vines reached its peak during harvest.



	Baseline: 6/21/2013	7/7/2013	7/14/2013	7/28/2013	8/4/2013	8/11/2013
♦ Control	1.800	2.367	2.633	2.167	2.383	2.517
■ Chemical	1.700	2.417	2.333	2.017	2.517	2.800
▲ Ozone	1.700	1.367	1.417	1.217	1.300	1.250

During normal vintage conditions in Nebraska in 2013, ozone-treated Brianna vines fared far better, showing lower disease pressure than those treated chemically or left untreated.

Overall, disease pressure on the treated vines was measurably lower in 2012, which was a dry year, and significantly less in 2013, which was characterized as having normal vintage conditions.

For the last five years, Arapahoe, Neb., grower Gary Thompson of Old Cellar Vineyards has used AgriOzein on his 11-acre vineyard planted to cold-hardy varieties including Marquette, Brianna and La Crescent. "The quality of fruit from our chemical-free vineyards is extraordinary," said Thompson, who will gauge the effectiveness of ozone on several acres of newly planted Petite Pearl this year. Wilmink and McFarland will have the opportunity to present these and other findings at the upcoming VitiNord conference, which will be held in Nebraska City in November.

Earlier this year, Wilmink visited the Viti Agro Campus in Beaune, France, where he worked in conjunction with viticulture professor Laurent Taccard to demonstrate and teach ozone technology. The school has sent student Alexis Schoepfer to the U.S. to research ozone use, and an AgriOzein unit is being trialed at Schoepfer-Muller in Wettolsheim, Alsace, an estate that was established in 1656.

According to Wilmink, the University of Purpan near Bordeaux, France, has done extensive research on treating vine diseases using ozone and the technology is being trialed by German and French winegrowers working in the Mosel, Rheingau, Burgundy and Bordeaux. With the French government mandating a 50% reduction in agricultural chemicals by 2018 and a push to expand certified organic farmland from 2% to 20% by 2020 underway, there's little doubt that demand for chemical-free alternatives such as ozone will increase.

ONGOING RESEARCH

Questions raised at the VitiNord conference about the environmental impact of ozone resulted in further testing on the effects of ozone on native yeasts populations. At the request of Netherlands enologist Stan Beurskens, samples of ozone-treated and chemically treated grapes from the Alsace region were tested at Sofralab in the Champagne-Ardenne region. The samples were incubated for four days and then evaluated by Beurskens, who directs St. Martinus Vineyard in Vijlen, Netherlands. Test results reported a considerable quantity of natural yeast in the ozone-treated sample – a predictable outcome given that ozone applied as a contact solution wouldn't come into contact with all of the yeast present on the grapes or vine.

In an effort to deal with specific pest issues on different grape varieties, Wilmink has divided varieties into low-, medium- and high-risk disease categories and made the output of his latest sprayer model, the Ozero, adjustable. In California, Bacigalupi points to an experimental ozone application currently being researched for treating red blotch. Plant material is dehydrated and then soaked in ozonated water so it takes up the O3 as a systemic treatment.

Anecdotal evidence that grapes from ozone-treated vineyards result in better wine quality abounds in Nebraska, which has the longest track record with the technology. In 2014, a Mac's Creek Winery & Vineyards wine made from 100% ozone-controlled Edelweiss grapes, won a gold medal at the Florida State Fair International Wine Competition.

Thompson, whose Nebraska vineyards have been chemical-free for five years, is lauded by local winemakers for the quality of his fruit and the wines it produces.

As a number of California growers have embarked on their first vintage using ozone, the jury is out until finished wines can be evaluated against a control. For the time being, early adopters like Bacigalupi and Bowland are focused on the safety and unlimited efficacy of using ozone without the risk of building resistance in pests.

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